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METHOD FOR LIGHTWEIGHT REPRESENTATION AND COMPARISON OF CAD FILES

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METHOD FOR LIGHTWEIGHT REPRESENTATION AND COMPARISON OF CAD FILES

ABSTRACT

A method and system are proposed to greatly reduce the size of computer aided design (CAD) files. The system represents and stores the CAD files as a sequence of operations to create the end object. The sequence of operations describes the CAD geometry including a range of mathematical descriptions in text form. The CAD file is structured as a hierarchical set of operations. Each change in operation is stored as a delta version taking up very little storage space. Major versions are saved with graphics for quick view, similar to current CAD files storage. The textual representation of the CAD file is used for comparing and merging of parts/features if needed. The lightweight file size is easier for performing meaningful diff operations such as merging of different versions for collaboration and version management. Backups are made possible for every change allowing fine grained return to any previous state.

BACKGROUND

CAD files are a digital representation of man-made designs or real world objects. CAD files usually are composed of drawing elements like sketches (curves, points, patterns), feature operations (extrude, cut, pattern, shell, fillet, holes), surfaces (curves, constraints), etc. Each item in a feature can have a bin of attributes such as location in space, length, wall thickness, and curvature constraints. The CAD files in engineering applications are usually large and stored in custom binary format. Performing meaningful diff operations (similar to software development tools) like comparing and merging different versions of files for better collaboration and version management on large files is challenging. The size of files is a pain point when doing regular activities such as sharing of files, network transmission of files and

backups. Backups are therefore manual operations which are generally performed many times a day in the office environment.

Further, currently, each CAD file can only be modified by one person, and multiple versions cannot be combined. A person must "lock" the file to make changes prohibiting any other engineers from working on the file. Also, CAD versions are stored as an entire file of graphics causing a large file to use available memory. There is no method available so far that reduces the size of the CAD files for easy backup or sharing. A method and system are proposed here to reduce the representation of CAD files to small-sized text files to address some of the above problems.

DESCRIPTION

The proposed system and method represents and stores the CAD files as a sequence of operations to create the end object. The sequence of operations describes CAD geometry including a range of mathematical descriptions like points, lines, polygons and annotations and additional representations such as 2D or 3D arcs, splines and 3D planar or free-form surfaces.

The various operation types could be represented as:

Sketches

- incl. 1, 2, 3D point data
- curves
- patterns

Features

- Typically depend on sketch
- Include items like Extrude, Cut, Trim, Shell, Copy, Save, Import, Delete
- Each has feature data like distance, thickness, relations to other features, etc.

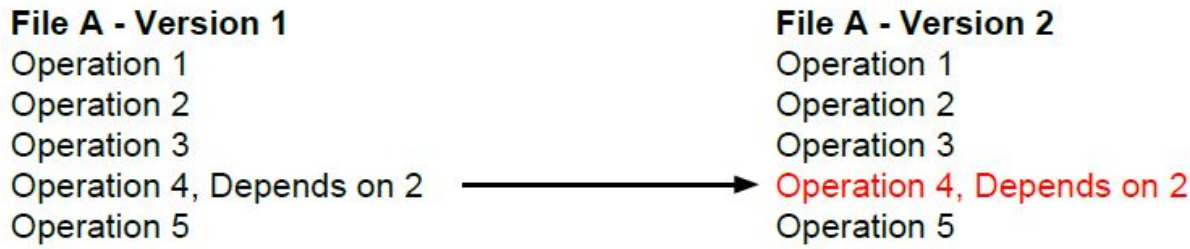
The CAD file could be structured as shown below:

CAD File Structure

Operation 1

Operation 2
Operation 3
Operation 4, Depends on Operation 2
Operation 5, Depends on Operation 3
Operation 6, Depends on Operation 5

Versioning and comparison: Each change in operation is stored as a delta version taking up very little storage space. Major versions are saved with graphics for quick view, similar to current CAD file storage. The textual representation of the CAD file is used for comparing and merging of parts/features if needed. Comparison can be done at the feature level or at the attribute level. An example of diff operation showing comparison at the feature level is given below:



Comparison at attribute level would include items similar to what is shown below with suggested menu choice of merge operations in parentheses:

- Point in sketch has moved locations (select correct, reposition, or combine)
- Point was deleted (designate point if dependent operations on that point's location, undo delete, keep delete)
- Curve change (keep, discard)
- Feature length change (keep, discard)

The feature list allows diff/merge to resolve conflicts and compare between different versions of lightweight files.

Using this method, the size of illustrated CAD files can be reduced. The resulting lighter weight file size is comparable when performing meaningful diff operations such as merging different versions for collaboration and version management. The small representation allows complete history tracking of all changes in the design and not just at the save points. The reduced size also alleviates the misery involved in sharing, network transmission and frequent backup of larger CAD files. It is also much easier to do backups for any number of times in a day. Backups are made possible for every change allowing fine-grained return to any previous state.